CENTRAL INTELLIGENCE AGENCY REPORT NO.

RESTRICTED
INFORMATION REPORT

P&P 376

COUNTRY Brazil

DATE DISTR. 26 Oct 1948

SUBJECT Report on Monazite Properties of Foote Minerios Industrializados Limitada (FOMIL)

NO. OF PAGES 1

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STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Liaison Branch, 1318 "M" Building DATE: 28 October 1948

FROM : Chief, Graphics Register, OCD

SUBJECT: Enclosures [redacted] 25X1A

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[redacted] 25X1A

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2. Suggest no concern unless 30 day period exceeded or when special need for a given incl indicates need for expedite action in which case we will try to expedite.

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Liaison Branch, 1318 "M" Building

28 October 1948

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Lindsay Light & Chemical Company

REPORT ON MONAZITE PROPERTIES OF FOOTE MINERIOS INDUSTRIALIZADOS LIMITADA (FOMIL)

Vitoria, E. E. Santos, Brazil

M. W. Eichelberger and
Howard E. Kramers

September 27, 1948

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Atomic Energy Commission
National Carbon Company
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James S. Murray
Research file
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Lindsay Light & Chemical Company

REPORT ON MONAZITE PROPERTIES OF FOOTE MINERIOS INDUSTRIALIZADOS LIMITADA

(FOMIL)

Vitoria, E. E. Santo, Brasil

M. W. Eichelberger and
Howard E. Kramers

September 27, 1948

1. INTRODUCTION

During the period August 15 to September 12, 1948 we made a brief survey of the monazite properties at present controlled by FOMIL. The survey was made to determine the monazite potential of FOMIL's properties and the actual and potential monazite production of FOMIL.

All inspections of FOMIL properties were made with the guidance of Edward Kraft (general manager) and James Crawford (superintendent). Although certain other phases of FOMIL were inspected, such as their Sapucia beryl mine (20 km. from S. Tome, Minas Gerais), only brief reports on these activities are given here.

Much of the information on the areal extent of the mines was obtained from Kraft.

2. FIELD TESTING EQUIPMENT

Inasmuch as it was impossible to bring large samples to the United States, many of the tests herein reported were made in the field. The testing equipment consisted of (1) a portable beta-gamma Geiger-Mueller survey meter (Beckman model MX5, AEC model SGM 15A Serial No. 1106), (2) hand spectroscope, magnifying glass, etc.,

and (3) comparison standards for monazite sand consisting of mixtures of sand of the following compositions:

	Per cent Composition						
Monazite	1	2.5	5	10	25	50	100
Ilmenite	55	55	55	55	55	35	---
Zircon	35	35	35	20	10	10	---
Silica	9	7.5	5	15	10	5	---

The sand mixtures were glued on cardboard, and the cards thus obtained were covered with celluloid for protection. The standards were carried in a two-piece cigaret case which was used as a volumetric measure in panning tests. The standards were extremely helpful, but they should have included the range 50 to 100%.

Volumetric measurements were made of panned concentrates, and calculations were based on a bulk value for heavy mineral sand of 2.14 to 2.43 g./cc.

Where analyses are reported with an analysis number (AN), the assays were made at our laboratories. Mineral analyses were made by magnetic separation (Operation Manual, Part 2, C, M-200), and chemical analyses were made by our standard monazite analysis method (Operation Manual, Part 2, C, R-1).

3. MONAZITE DEPOSITS CONTROLLED BY FOMIL

At present, the principal Brazil monazite deposits consist of modern and recent marine beaches along the Atlantic coast in the states of Rio de Janiero, Espirito Santo, and Bahia. These beach deposits vary both in the content and the composition of their heavy sands. The heavy mineral concentrates consist predominantly of ilmenite, monazite, and zircon. In addition to beach sands, nearly all of the rocks and clay derived therefrom contain monazite. It is entirely probable that monazite-bearing rocks extend at least 100 miles inland

along much of the Atlantic coast bordered by the states of Rio de Janiero, Espirito Santo, and Bahia. As a matter of fact, panning tests of clays derived from the country rock in many parts of Espirito Santo showed appreciable amounts of monazite.

The Brazil beach deposits are of two types, recent and modern, represented schematically in Figures 1 and 2.

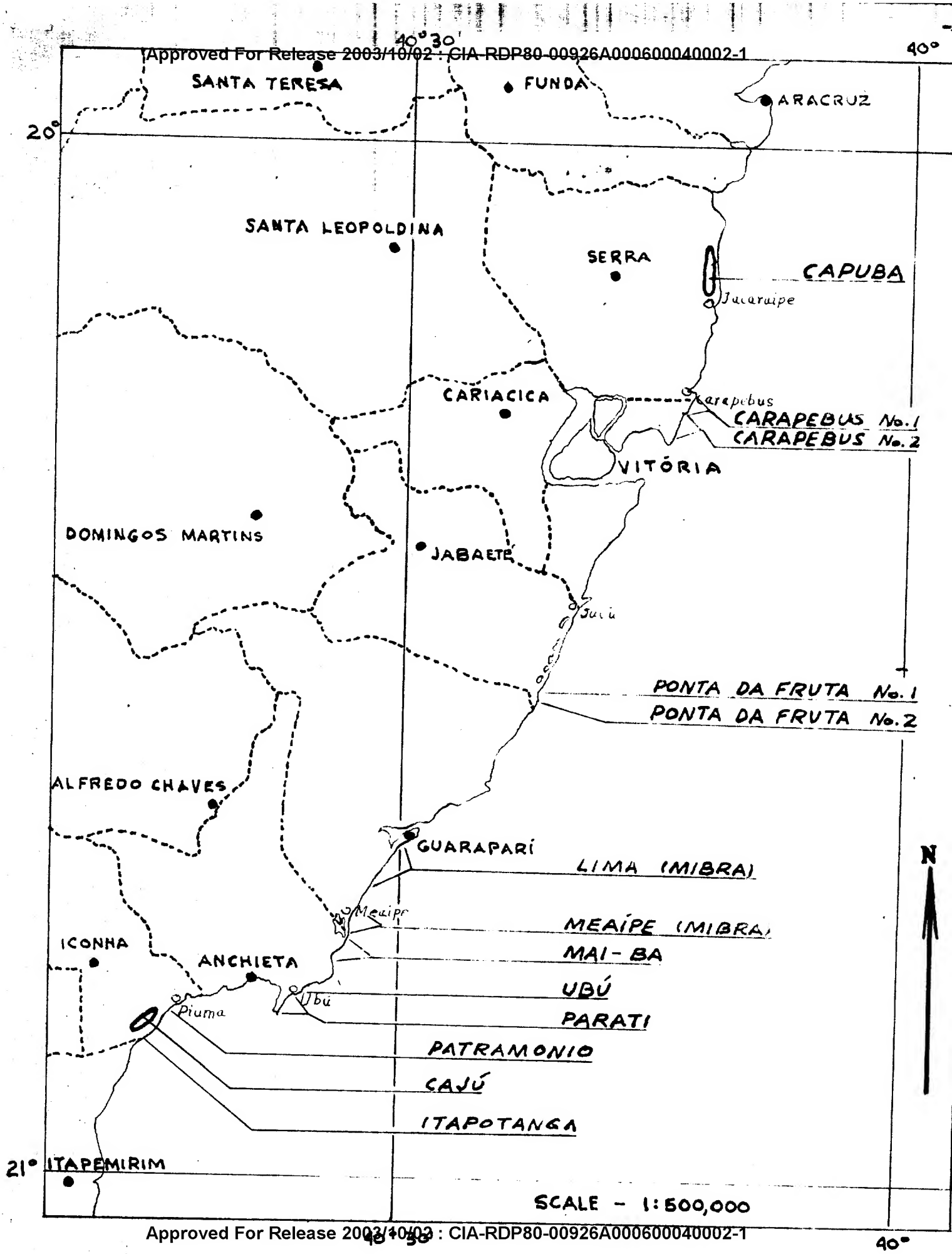
FOMIL monazite deposits are in Espirito Santo and are named as follows (see map for location):

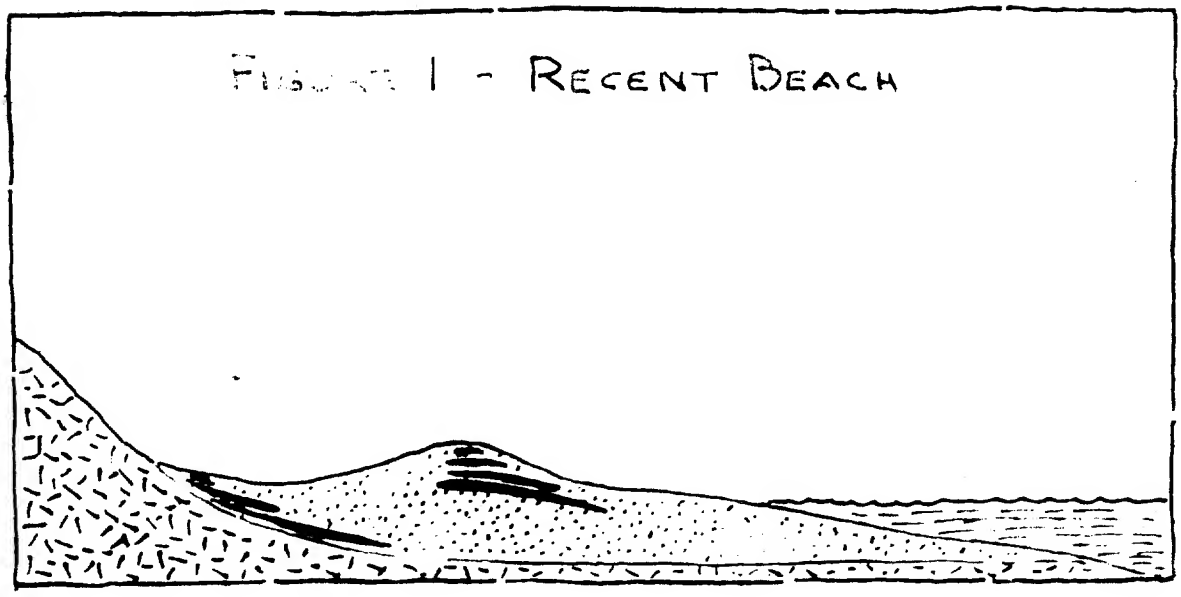
Name	Former owner or Lessor
Capuba	du Pont
Carapebus No. 1	du Pont
Carapebus No. 2	du Pont
Ponta da Fruta	du Pont
Mai-Ba	Torres
Parati	Torres
Patramonio	Torres
Caju	Torres

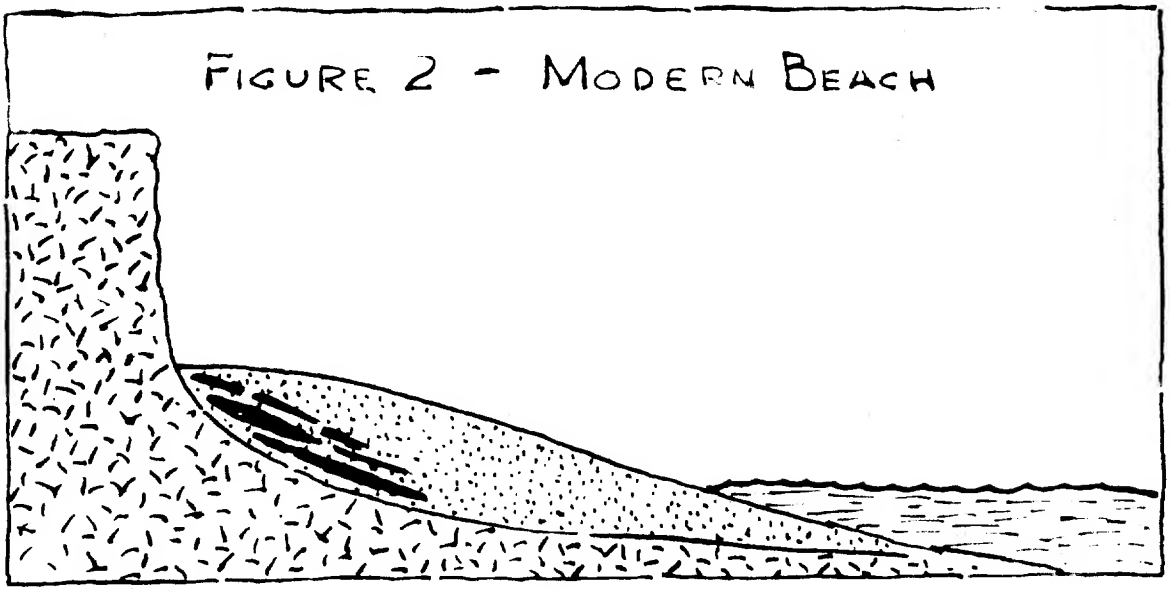
In addition FOMIL has first rights to mine I t a p o t a n g a, when such rights are granted by the DNPM. FOMIL is also considering the pruchase of the U b u mine which is owned by a farmer at Ubu, E. E. Santo.

The Torres properties were leased to FOMIL for a three year period beginning Jan. 1, 1947 on a royalty basis of Cr$600 per metric ton refined monazite produced. The du Pont properties are now in FOMIL's name and were obtained from du Pont when the latter ceased ilmenite prospecting in Brazil.

FOMIL has prospected all of their properties. Their prospecting method consisted of taking samples with a post hole digger until clay or water was reached (up to 6 meters deep). The overburden sample was discarded, and a representative sample of the concentrate sand layer (if present) was made by quartering. Concentrate sand lenses were thus outlined and the depths noted. Sampling was usually done every 50 meters. The samples were taken to the Vitoria office, and after washing, grain counts were made. We consider the sample taking method as being adequate, but we do not believe that the grain-count analysis is too reliable since the sands are not homogeneous with respect to grain size.







At the time of our visit, FOMIL had not completed assays of many of their samples.

C A P U B A

This is a recent beach deposit about 2 km. long situated about 30 km. NNE of Vitoria and about 300-500 meters from the present beach. Du Pont formerly considered working the area for ilmenite. We did not see much of this property; no good mining areas were visited.

FOMIL is doing no mining at Capuba, but intends to mine it for zircon sand.

Du Pont reported the average composition of the sand in the mine is as follows:

Ilmenite	11.38%
Second class ilmenite	1.47
Monazite	0.68
Nonmagnetic	8.47
Quartz	77.99

and estimated the mine to contain 11,500 metric tons of ilmenite. Based on this, the mine contains 680 metric tons of monazite. However, Kraft says that the du Pont prospecting did not take into account the generally accepted rule in such deposits that monazite tends to concentrate in the deeper parts of the deposits; the du Pont prospecting was shallow, and test holes were not made to clay or water. We have heard that du Pont now admits that their data on the monazite contents of their Brazil prospects are too low.

C A R A P E B U S Nos. 1 and 2

These mines are located about 20 km. NE of Vitoria and are of the recent type. The mines total about 4 km. in length and the mineable areas were reported to be up to 30 meters wide. The heavy sands consist of ilmenite, zircon and monazite.

Du Pont reported that the average composition of the sand on Carapebus No. 1 was as follows:

Ilmenite	10.18%
Second class ilmenite	5.55
Monazite	0.47
Nonmagnetic	6.33
Quartz	82.45

Du Pont estimated that a 10 cm. thick layer of concentrate contained on the property would contain 40,480 metric tons of ilmenite. On this basis, the same layer would contain 1,850 tons of monazite. FOMIL's test holes showed a rich lens of sand on Carapebus No. 1 which was missed in the du Pont prospecting.

Only a small portion of one ore body on Carapebus No. 1 was visited. Three ore bodies on Carapebus No. 2 were confirmed with the Geiger meter. Meter readings of 0.05-0.15 mr/hr. were observed (background 0.02 mr/hr.). at points indicated by Kraft to contain lenses of heavy sands. Confirmations of ore bodies disclosed by FOMIL was satisfactory with the Geiger meter provided the ore layers were not too deeply buried. The three ore bodies on Carapebus No. 1 were reported to have average thicknesses of one meter, widths approximating 10 meters, and lengths of about 300 meters. Panning tests of mined concentrate showed about 50% heavy sands and 2.5% monazite (about 5% monazite in the heavy mineral concentrate).

Panning tests of "barren" sands showed about 0.5% monazite.

Considerations of du Pont's surveys indicate that Carapebus No. 2 may contain 2,000-3,000 tons monazite. Including the "barren" sands, it is estimated by us that the mine contains at least 25,000 tons monazite.

FOMIL's surveys indicate five ore bodies, and Kraft estimates that these five deposits contain 2,500 to 3,000 tons of monazite, not considering the barren sands.

At the north end of Esperito Santo Bay, we saw a small beach of modern type (Fig. 2) which consisted of black sand containing about 5-10% monazite. Clay from the cliffs near by showed approximately 0.1-0.5% monazite on panning.

Part of Carapebus No. 2 was worked about 20 years ago by the French. Two stockpiles of unwashed beach concentrates were left on the property. Geiger meter readings on the two piles were 0.1 to 0.15 mr/hr., and panning tests showed that the material in the piles contained about 50% heavy sands and 2.5% monazite (or 5% monazite in the heavy mineral concentrate). The two piles were estimated to contain about 500 to 1,000 tons of heavy minerals.

P O N T A D A F R U T A

The Ponta da Fruta mines Nos. 1 and 2 are located near the village of Ponta da Fruta, about 35 km. S of Vitoria and about 20 km. NE of Guarapari.

The deposit is of the recent type. The No. 1 mine is 4 km. long and the adjacent No. 2 mine is 2 km. long. The thickness of the natural concentrate layer was reported by FOMIL to be 1-3 meters and about 20-30 meters wide.

Du Pont's estimation of the average composition of the sand at Ponta da Fruta No. 1 was as follows:

Ilmenite	12.65%
Second class ilmenite	4.11
Monazite	0.43
Nonmagnetic	14.96
Quartz	67.85
	100.0

They estimated that the mine contained 61,000 metric tons of ilmenite; on this basis it should contain 1,500 metric tons of monazite. More monazite than this is present because the du Pont surveys did not include the lower natural concentrate layer where the monazite content of the heavy mineral sands is greater.

FOMIL had not completed calculations of their prospecting test holes at the time of our visit. Geiger meter prospects by us showed that the mine contained considerable monazite.

FOMIL started mining at Ponta da Fruta No. 1 in 1948, intending to ship a zircon-ilmenite mixture to the Foote Mineral Co. of Philadelphia. However, when mining was started it was found that the amount of monazite in the concentrate was so high that shipment of the concentrate was impossible. Mining was done by washing off approximately 3 ft. of overburden sand with a hydraulic gun, and then the underlying 6-10 ft. of natural concentrate layer was pumped with water over six rougher tables and four cleaner tables. The table tailings were pumped to the beach. The heavy mineral concentrate thus produced was to be loaded onto a barge at the beach (100 ton capacity) and was to be shipped to Vitoria. Mining operations were suspended pending the installation of separation equipment at Vitoria. Production from the tables averaged 0.5 ton heavy minerals per hour per table for six tables. Only a small stock of concentrate was made and this is at the mine.

A sample of the heavy mineral concentrate produced by the tables had the following analysis (AN 485129):

Ilmenite	46.0%	
Monazite	13.4	
Nonmagnetic	40.6	(largely zircon)
	100.0	

Assuming that the mined sands contained 50% heavy minerals of the above composition, the mine would contain 110,000 tons heavy mineral concentrate or 50,600 tons ilmenite, 14,700 tons monazite and approximately 45,000 tons zircon, exclusive of these minerals contained in the overburden and "barren" sands.

M A I-B A

The Mai-Ba mine is a modern beach deposit located on the present ocean beach adjacent to Lake Mai-Ba about 10 km. from Anchieta. It is about 2,000 meters long and the mineable area is about 10-15 meters wide adjacent to abrupt clay cliffs which are about 20 to 30 meters high.

This is the only FOMIL beach mine being worked. Operations were started on May 13, 1948.

Mining is done by removing approximately 10 ft. of overburden sand near the cliff base. The thusly exposed layers of monazite and black sand are shoveled out selectively. The monazite bearing veins vary from 1 cm. to 1 meter thick, the average of those seen was about 10 cm.; and the total vein thickness removed is about 0.5-1 meter. The natural concentrate they removed is supposed to be roughly adjusted at the mine to contain about 20% heavy minerals. It is transported by truck to the mill located about 100 meters from the mine. After storms, considerable monazite concentrates are found on the beach, and these are scraped up and temporarily stored in piles on the beach for transportation to the mill.

The monazite-rich veins exposed in the mines often consist locally of 70-80% monazite, and occasionally, cemented monazite sandstones are found adjacent to the cliff.

At the mill, a reserve stock of about 4,000 tons of mined sand is kept on hand for tabling in case of inclement conditions on the beach which prevent mining. This stockpile was sampled and analyzed as follows (AN 485126):

+20 mesh	9.0%
Ilmenite (plus garnet)	27.4
Monazite	12.3
Nonmagnetic	51.3
	100.0

The mined sand at this mill is shoveled into a launder and the sand slurry flows by gravity onto two Deister tables having 4 ft. X 10 ft. decks. The tables were somewhat overloaded, and a concentrate containing about 55-70% monazite was produced at the rate of approximately 1-1.5 ton per hour per table. The monazite recovery was estimated to be about 60%.

Tailings from the tables flow by gravity to a pump where they are presently pumped to a pile located between the mill and beach. FOMIL eventually contemplates pumping the tailings directly to the beach, a distance of about 100 meters, when pipe can be secured.

Analysis of a sample of tailings taken Aug. 18,1948 showed (AN 485124):

28.7% ilmenite
3.5% monazite
67.8% nonmagnetic sands

Monazite concentrate from the tables flows into boxes (2 cu. meter capacity) where the excess water is drained off. From these boxes, the concentrate is shoveled to a temporary stockpile which is trucked to a warehouse on the wharf at Anchieta. There it is bagged for barge transportation to the magnetic separation plant at Vitoria.

Production of tabled monazite concentrate averages 1.0-1.5 ton per hour per table. For a 20 hour day, 26 day month, the production from two tables could therefore be over 1,000 tons of concentrate per month. The actual average production rate has been about 200 tons per month on account of stoppages and one shift operation.

A sample of tabled concentrate such as is shipped to Anchieta (taken Aug. 18, 1948) analyzed (AN 485121) as follows:

Ilmenite (+garnet)	38.2%
Monazite	40.0
Nonmagnetic	21.8
	100.0

On Sept. 23, 1948 we received a sample of Mai-Ba table concentrate from Kraft which analyzed (AN 485140):

Ilmenite	19%
Monazite	70
Nonmagnetic	11 (largely zircon)
	100.0

From panning tests we estimated that the "barren" sand on the beach surface contained about 2% heavy minerals and 0.05-0.1% monazite. The entire mine may contain 20,000-30,000 tons of monazite in the high grade veins now being mined and it may contain an equal amount in the overburden "barren" sands. Kraft believes that any estimate of the amount of monazite in the mine is impossible because he reports that mined-out holes can be re-worked after storms;

in fact he reported that one hole has been mined four times to date.

It is our opinion that additional tables should be installed at the mill to give greater monazite recoveries. FOMIL plans to install a third table to wash the tailings from the present two tables to recover additional monazite and an ilmenite fraction which will be stockpiled at the mine and returned to Torres ownership.

The quality of the monazite produced by us at our laboratory by magnetic separation was satisfactory. Analysis of such separated monazite obtained from various Mai-Ba samples during the course of their mineral analyses were as follows:

Analysis Number	% Total Oxides	% ThO_2
485114	69.2	7.1
485116	68.2	7.2

A "clean" monazite produced on the FOMIL magnetic separator from Mai-Ba concentrates analyzed (AN 485132) 66.2% total oxides and 6.2% ThO_2.

U B U

The Ubu deposit is of the recent type and is located at the fishing village of Ubu. It is about 2 km. long and is just south of Mai-Ba. The deposit is similar to the Parati deposit. It was partially worked for monazite in 1928 by Societe Franco Brasileiro (the old MIBRA company). It is at present owned by a Brazilian fisherman living at Ubu. FOMIL has no mining rights to the property but is considering obtaining them.

P A R A T I

The Parati deposit is of the recent type and is located just south of Ubu. It is about 2 km. long It has been partially mined by Torres, and at present the mine sands belonging to Torres are being washed by him in "dollies" and the concentrate containing about 50% monazite is sold to MIBRA for Cr$600 per ton of contained monazite. FOMIL estimates that the dolly operation will be completed by the end of 1948.

FOMIL eventually plans to work the mine in much the same manner that Mai-Ba is being worked. Monazite concentrates from Parati probably will be similar to those obtained from Mai-Ba.

P A T R A M O N I O

The Patramonia deposit is of the recent type and is located just south of the village of Piuma. The mineable area is about 2,000 meters long and consists of surface layer of concentrate about 1 meter thick and 15 meters wide. A sample of the concentrate analysed (AN 485130) as follows:

Ilmenite ----------	63.4%
Monazite ----------	3.4
Nonmagnetic ----------	33.1
	100.0

according to this, the concentrate vein contains 42,000 tons ilmenite and 2,200 tons monazite.

C A J U

The Caju deposit is of the recent type and is located about 2 km. south of Piuma. It is reached by canoe from the costal road. Portions of it have been worked by Torres, and there are several stockpiles of washed sand at the mine.

At Piuma, a stockpile of 740 tons of "ilmenite sand" (washed sand from Caju) is being considered for purchase by Kraft. According to his analysis it contains 15.4% monazite. Our analysis of the material showed 70.9% ilmenite, 7.9% monazite, and 21.2% nonmagnetic (AN 485131).

The Caju deposit is about 4 km. long and is situated near an ample source of fresh water.

I T A P O T A N G A

The Itapotanga deposit is of the recent type and is located about 7 km south of Piuma. FOMIL has no mining rights to the property, but has a protocol on its claim. The mineable area is about 3.5 km. long and 5-10 meters wide.

Analysis of a sample of the heavy mineral vein showed (AM 485125)

Ilmenite	51.9%
Monazite	1.5
Nonmagnetic	46.6
	100.0

Per meter of depth, the mineable deposit would contain 57,600 tons of ore (2.2 tons per cu. meter), or 30,000 tons ilmenite and 860 tons monazite. If the deposit has 3 meters of mineable material, it would contain 163,000 tons ilmenite and 2,600 tons monazite exclusive of the lower grade overburden sands.

4. MAGNETIC SEPARATION PLANT

The "MS" plant is located in a rented warehouse on a wharf on the main ship channel into Vitoria. Access at present is best by boat from Vitoria or Villa Velha. The labor supply comes from Villa Velha.

The building consists of two large rooms of approximately equal size and has about 5,000 sq. ft. floor area. One is used for bonded monazite concentrate storage. CESBAG, the bonding agency, maintains a fiscal at the MS plant. The other room contains power generating equipment and a magnetic separator. Equipment is as follows:

One - Superior Diesel Generator, Model CUB-6 (National Supply Co., Superior Engine Division, Springfield, Ohio), used. The generator is a Westinghouse marine generator frame 6-28-6, type C, 125 KVA, 3 ph, 60 cyc., 80% PF, 450 volts, 160 amps, 1200 r.p.m., made 1944. Condition - fair to good.

One - AC-DC converter, used, motor driven by a 20 hp, 440 volt, 25 amp. motor. Generator: 250 volts DC, 60 amp. CPD wound, North Electric Motor Co., New York, N. Y. frame 1520, type 60, make "Ther". Condition - good.

One - Hamco-Hope 6 cross belt magnetic separator, type CB, No. 15501 230 volts, 24 in. main belt, with variable speed drive. Manufactured by Magnetic Engineering & Manufacturing Co., Clifton, N. J. New - unsatisfactory.

One - Rotary Drier, oil fired, condition and performance good.

Preliminary trials of the separator on Mai-Ba concentrates indicated unsatisfactory performance of the machine. Further trials by us were summarized in a report as follows:

MEMORANDUM

To: Charles R. Lindsay, III
From: Howard E. Kremers September 5, 1948
Subject: MEMCO-HOPE MAGNETIC SEPARATOR AT THE FOMIL "MS" PLANT.

Following is a summary of my observations and opinions on the performance of the Fomil magnetic separator. All tests were made in the presence of either J. Crawford or Ed Kraft. Mai-Ba concentrates containing about 60 to 70% monazite were used.*

When first seen, the machine was adjusted by the MS personnel and was giving an ilmenite-garnet mixture on the first three poles, and a clean monazite on the last three poles. The machine was operating at maximum amperage at 230 volts, and was producing cleaned monazite at the rate of approx. 25 Kg. per hour (0.5 ton per day). Slight adjustments to decrease the air gaps between the main and cross belts gave a slightly better yield. With the air gaps as small as possible (less than 1/8 inch), time tests at varying amperages indicated that the last three poles were operating very close to maximum magnetic flux.

After various adjustments had been made we were able to increase the yield of monazite to approx. 100 Kg. per hour. The following data were taken after a two-hour "warm-up" period:

Feed rate: 424 Kg./hr. (maximum possible)
Belt speed: approx. 50-60 ft./min. (slowestpossible; increase in belt speed gave poorer results)
Air gap: less than 1/8 in. (as small as possible)
Voltage: 270 volts (the machine is rated at 230 volts)

Pole	Amps	% removed	Composition of sand
1	7.0	15.3	ilmenite-garnet
2	6.8	7.3	ilmenite-garnet
3	6.5	8.2	90-95% monazite
4	8.2	7.8	90-95% monazite
5	11.8	2.9	90-95% monazite
6	12.8	4.7	90-95% monazite
Nonmagnetic		53.8	approx. 60% monazite
		100.0	

Yield: Approx. 100 Kg. monazite per hour from poles 3, 4,5, and 6. Approx. 24% of the head feed was removed as monazite. Approx. 35-40% of the monaazite present in the head feed was removed in one pass.

The machine was being overloaded by operation at 270 volts. The coils had an outside temperature of approx. 55°C. ** The motor driving the ac-dc converter was running at about a 45° C. temperature rise. Continuous operations under such conditions would be inadvisable.

Further attempts were then made to obtain monazite-ilmenite fractions on poles 2-6 which could be separated into ilmenite middlings and clean monazite by splitting the two streams of sand as they came off the cross belts. With the machine operating at 250 volts, and after a two hour warm-up, the best monazite yield was obtained. The recovery of cleaned monazite on one pass was found

* Analysis of the sand showed the actual monazite content to be about 56%.

** We understand that the coils were wound with glass [illegible] so this temperature is not excessive.

to be not more than 50-60 Kg. per hour. The yield could not be improved because the shading on the first pole was out of alignment with the other poles; at high feed rates a ridge of ilmenite was left on the crossbelt-discharge side of the main belt so that it interfered with the removal of sand from the subsequent cross belts At high feed rates, the monazite fractions were badly contaminated with this ilmenite. Attempts to correct this condition by changing the position of the main belt were not successful. The only correction is to retap the first pole and relocate the brass shoes. With such correction, the capacity undoubtedly can be increased.

The sand splitters on the cross belts are poorly designed. It is impossible to make satisfactory adjustments with the present equipment. The sand receivers should be modified so that control can be made by adjusting vanes to split the monazite and ilmenite sand streams.

Repassing the nonmagnetic tailings which contain approx. 30-60% monazite does not give a satisfactory recovery of clean monazite. Apparently the magnets are not strong enough to pick up the more weakly magnetic monazite sands.

It has been consistently observed that a slightly better separation is obtained with warm feed sand. However, at the last operation of the separator using warm sand (approx. 45°C.), trouble was encountered with the main belt. Although it was not stretched too tight, the joint in the belt began to loosen resulting in a troublesome bow in the middle of the belt. Before further operation, the belt will have to be repaired. The belt joint should be vulcanized.

It is possible to completely remove ilmenite from the sand on all six poles without removing monazite. This gives a monazite; zircon; quartz nonmagnetic tailing at the rate of 0.5-1 ton per hour. It may be possible to obtain a fairly satisfactory monazite product by screening these tailings. A screen is now being set up at the MS plant to investigate this possibility.

All of the suggestions offered by Foote in thier cables of the past week have been tried. With appropriate alterations of the machine, it may be possible to produce 75 Kg. cleaned monazite per hour (450 metric tons per year at 20 hours per day and 300 day year operations).

In my opinion, the separator is poorly designed in the following ways:

1. The magnets are too weak.
2. The first pole is out of alignment.
3. The cross belts are too thick.
4. The main belt is not vulcanized and is slightly irregular.
5. The sand splitters on the cross belt receivers are poorly designed.
6. The rheostats for pole control are too small (one has been burned out to date).

Cost estimates:

The diesel generator and drier each consume about 15 liters of oil per hour. The oil costs Fomil Cr$1.35 per liter. For 20 hour day operation, the oil cost is approx. US$40.00. Labor costs at the MS plant are approx. US$15.00 per day. For a daily 20 hour operation with a recovery of 100 Kg. cleaned monazite per hour (2 metric tons per day), the separation cost would be about US$27.50, exclusive of overhead, maintenance, mining costs, etc.

/s/ H. E. Kremers

cc: Foote Mineral Co.
Edward Kraft
Richard P. Momssen, Jr.
H. E. Kremers
C. R. Lindsay III

Analyses of Mai Ba nonmagnetic tailings obtained by removing ilmenite on all six poles of the Memco-Hope separator were as follows (AN 485112):

The sample represented approximately 2 tons of material

Screen analysis

Mesh	%	% monazite
+20	0.2	0
-20+40	6.4	69
-40+60	58.0	86
-60+100	32.4	63
-100	3.0	46
	100.0	

Chemical analysis

Total oxides ---------- 52.4%

ThO_2 ---------- 5.3%

Mineral analysis

Ilmenite ---------- 2%
Monazite ----------76
Nonmagnetic ----------23
100%

Since the removal of ilmenite alone could be easily done with the separator, it was thought that screening this material through a 60 mesh screen would give a +60 mesh material which might be acceptable monazite, or could be blended with refined monazite to give an acceptable monazite. If practical, such a procedure might increase the FOMIL output of refined monazite. An experimental sample of ilmenite-free tailings produced by the separator and containing (AN 485128) 2.1% ilmenite, 72.5% monazite, and 24.4% nonmagnetic sands was screened on a 60 mesh screen. Approximately 60% of the sample was retained on the screen, and this material analyzed (AN 485110) 58.6% total oxides and 6.2% ThO_2 equivalent to 86% monazite. Consideration of the screen analysis above shows that screening the material on a 60 mesh screen would give a +60 mesh fraction containing 85% monazite. On Sept. 27, 1948 we received from Kraft a sample of Mai-Ba material from which the ilmenite had been removed on the FOMIL separator and which was screened at the MS plant; it analyzed (AN 485156) 84% monazite, 1% ilmenite, and 15% zircon.

In order to fortify this to 95% monazite, one part of the 85% material would have to be blended with two parts of 100% monazite. In order to increase the 85% material to 90% monazite, two parts of the 85% material would have to be blended with one part of 100% monazite.

When last seen in the early part of September, 1948, it was estimated that FOMIL separator had an annual capacity of 450-600 tons refined monazite from 55% Mai-Ba concentrate (20 hours per day, 300 day year operation), or a capacity of 4,500 tons per year of ilmenite-free 85% material to be screened. Thus, in order to produce 90% monazite, the capacity would be based on the potential clean monazite production, and the total yearly production of 90% monazite would be approximately 1,300 tons. Improvements in the design and operation of the separator would improve the yield.

BONDED SAND.

Approximately 420 tons of monazite concentrate are bonded at the MS plant; FOMIL draws against a letter of credit based on this sand containing 86% monazite.

Analysis of core samples of this stockpile are as follows:

Core Sample	AN	% ilmenite	% monazite	% nonmagnetic
1	485119	24.9	57.1	18.0
2	485120	25.3	57.3	17.4
3	485121	26.8	53.7	19.5
4	485122	27.5	53.7	18.8
5	485123	25.9	55.6	18.5
	AVERAGES	26.0	55.5	18.5

5. LABOR.

As of September 4, 1948, the following breakdown of personnel applied to FOMIL. Non-supervisory labor costs are figured at Cr$15 per day per person for a 26.day month; at US$0.05 per cruserio, this cost is US$19.50 per month. Mechanics and mine bosses receive Cr$2.500,00 to Cr$3.500,00 per month.

	US$ Monthly Salary	Totals
OFFICE		
Edward Kraft (General Manager)	250.00	
J. Crawford (Superintendent)	300.00	
Phillip Meddewar (Office Manager)	150.00	
A. Cabral (Purchasing, procurement)	100.00	
Joseph Graf (Geologist)	200.00	
Office boy	10.00	
3 - Office girls (typing, filing, assay, etc.	58.50	
		$1068.50
MAI-BA		
30 - laborers ($19.50 x 30)	585.00	
Chauffeur	50.00	
Mechanic (Cr$3.000,00 per month)	150.00	
Fiscal	125.00	
Foreman (Cr$3.000,00 per month)	150.00	
		$1060.00
"MS" PLANT		
8 - laborers ($19.50 x 8)	156.00	
2 - mechanics (Cr$3.000,00 per month)	300.00	
		$456.00
PONTA DA FRUTA		
Watchman	19.50	
		$19.50
SAPACIA BERYL MINE		
Kurt Volmer (Foreman)	150.00	
17 - laborers ($19.50 x 17)	331.50	
		$481.50
TOTAL		$3085.50

6. COMMENTS ON THE FOOTE MINERAL COMPANY REPORT ON FOOTE MINERIOS INDUSTRIALIZADOS, LTD., (GORDON CHAMBERS, 4-20-48).

Page 2.
B. Although one of the types of FOMIL's business is the buying of ores from small prospectors and miners (in particular, beryl ore), this activity has decreased markedly due to a lack of working capital.

C, D. The importation of materials for resale in Brazil has been limited. We do not believe that FOMIL at present has an adequate distribution program. Although opportunities for resale may exist in Brazil, it would appear best to investigate the actual market in Brazil before undertaking a resale program.

Page 3
MINING
RESERVES. According to Kraft, the mines Capuba, Carapebus No. 1 and 2 and Ponta da Fruta are now permanently owned by FOMIL. Also according to Kraft, there is little possibility of Vincent Torres extending the leases on Mai-Ba, Parati, Patramonia, and Caju.

Page 4
MINING
METHODS. Hydraulic mining of beach sands was practiced for only a short period at the Ponta da Fruta mine; this mine is at present closed down. Only Mai-Ba is being mined, and the sand is dug by hand and trucked to the mill. This mining is primarily for monazite; ilmenite eventually may be an important by-product; the zircon is reported to be of poor quality.

Only one beryl mine at Saparia is being worked; mica is being mined at this mine on a contract basis.

Page 5
EQUIPMENT. A sand concentrating plant consisting of six rougher Deister tables and four cleaning tables was erected at Ponta da Fruta; this is now shut down. The sand plant at Mai-Ba has two Deister tables.

The magnetic equipment at present consists of a rotary drier, cross-belt magnetic separator, conveyers, and a Diesel generator. The installation of an electrostatic separator at this time is not recommended.

Laboratory equipment at the FOMIL office is very limited. It consists of quartz crystal inspection equipment, a microscope, and surveying equipment. The analytical equipment and Geiger counter are inadequate.

Page 5
WATER AND
FUEL. Sea water is plentiful at the sand mines. The only mines with adequate fresh water are Mai-Ba and Caju.

Page 6
SAND
MINING. The FOMIL beach surveys at present are incomplete, although it is reported that all the necessary samples have been taken. The FOMIL grain-count method of assaying the samples leaves much to be desired, and it is our opinion that such tests should be made by more accurate methods.

Page 8
PERSONNEL. In the opinion of Kraft and Crawford, the geologist Joseph Graf is not suitable because he is not dependable. He should be used to make surveys, etc. but instead he has been doing non-geological work.

It is our opinion that the salary rates for the supervisors and engineers should be increased. FOMIL will not show a profit for several years, and to prevent discouragement, certain of the salaries should be increased.

7. BRAZIL MONAZITE ESTIMATE.

An accurate estimate of the amount of mineable monazite in Brazil is impossible to make because there are no adequate surveys. It is a fact that the potential production of Brazil monazite is tremendous.

The Brazilian DNPM estimates that the monazite resources of Brazil are about 200,000 tons. Such an estimate undoubtedly accounts only for monazite contained in the rich natural concentrate sand lenses on the modern and recent beaches. We believe the 200,000 ton estimate is low for the following reasons:

(1). Brazil mining practice is to "high grade" a mine with crude mining methods. The low grade material is discarded. In all of the beach mines, the amount of monazite contained in the "low grade" and "barren" sands at least approximates or is considerably greater than the amount contained in the high grade veins. Abandoned mines, such as the MIBRA Lima mine which is considered worked-out, could be profitably worked to recover additional monazite.

(2). Some mines, such Mai-Ba, are continually depositing monazite. The Experience of FOMIL in being able to remine mined-out areas after storms is an example of this.

(3). No surveys have been made of the monazite resources of beach sands lying below the water level. It is Brazilian practice not to mine below the water table because proper equipment is not used.

(4). The igneous country rock along the monazite-producing coast is the source of the monazite on the beaches. Nearly all samples of clay (derived from this rock) will show monazite on panning. If such clays were available in this country, serious consideration would be given to mining them for monazite. It was reported to us that clays as far as 100 miles inland from the coast will show monazite on panning. In the clay cliffs at Mai-Ba, monazite is easily visible at certain spots, and most random samples of the clay will show at least small amounts of monazite on panning.

The amount of such clays in Brazil is unlimited insofar as monazite production is concerned. From our observations, we estimate that the monazite resources of Brazil amount to many millions of tons.

A small monazite beach at Carapebus.

AREA 233H BRAZIL ESPIRITO SANTO CARAPEBUS 20 16 S 40 12 W
(WAC 1263). Small monazite beach. 1948.
Restricted

25X1A [redacted] 25X1A [redacted]

Ubu, E. Espirito Santo

AREA 233H BRAZIL E. ESPIRITO SANTO UBU 20 49 S 40 37 W
(WAC 1263) 1948.
Restricted

25X1A [redacted] 25X1A [redacted]

AREA 233H BRAZIL ESPIRITO SANTO PONTA DE FRUTA 20 32 S 40 23 W (WAC 1263) Monazite mine controlled by FOMIL. 1948.
Restricted

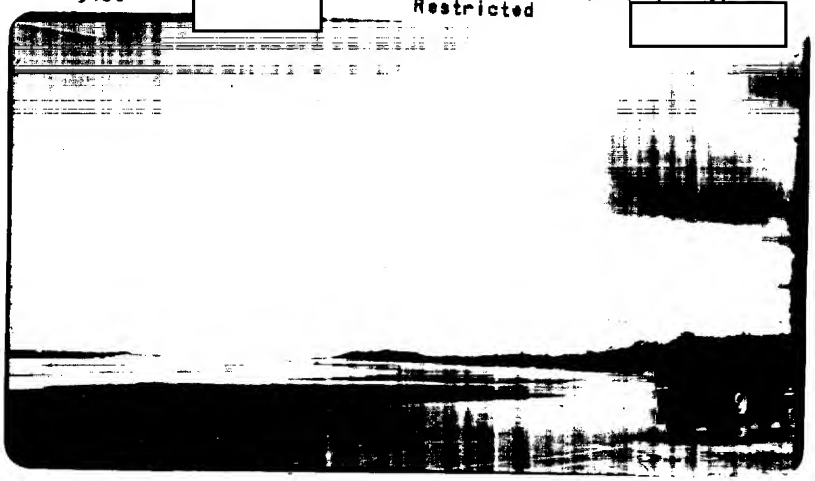
25X1A [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO PARATI 20 50 S 40 38 W (WAC 1263) Monazite mining controlled by FOMIL. Sand is mined from ridge immediately left of the beach. 1948.
Restricted

25X1A [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO PONTA DE FRUTA 20 32 S 40 23 W (WAC 1263). Monazite mine controlled by FOMIL. The buildings house pump and tabling equipment. 1948.
Restricted

25X1A [redacted] 25X1A



AREA 233H BRAZIL ESPIRITO SANTO PONTA DE FRUTA 20 32 S 40 23 W (WAC 1263). Beach mined for monazite. 1948.
Restricted

25X1A [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Beach mined for monazite. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Temporary piles of sand scraped from the beach surface after storms. (Monazite mining). 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

Mai-Ba mine. The holes are dug by hand and the monazite rich sand veins (dark streaks) are selectively removed. The mined sand is transported to the mill by truck (road against the cliff). Where no road is available, the sand is transported on hides to temporary storage piles.

25X1A

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Monazite mine controlled by FOMIL. 1948.
Restricted

25X1A

25X1A

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Monazite mining controlled by FOMIL. 1948.
Restricted 25X1A

25X1A

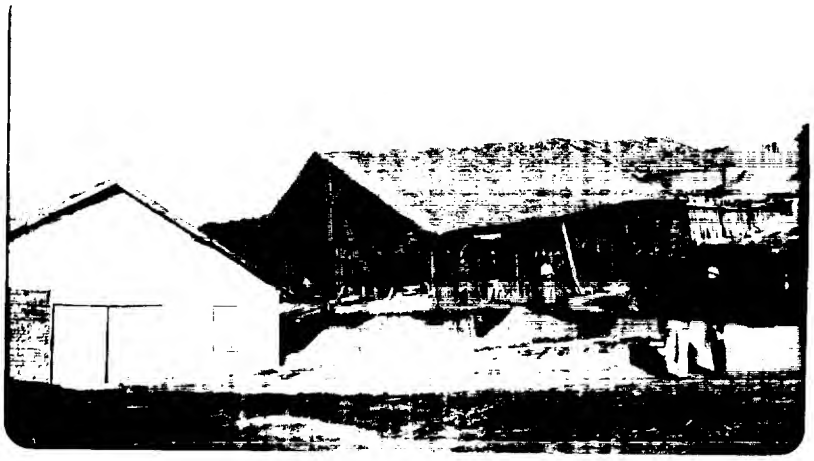
AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Monazite mining controlled by FOMIL. 1948.
Restricted

25X1A

AREA 233H BRAZIL ESPIRITO SANTO PARATI 20 50 S 40 38 W
(WAC 1263) Monazite mining controlled by FOMIL. Torres
dolly operations. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

Parati beach (Lindsay). Sand is mined from the ridge immediately left of the beach.



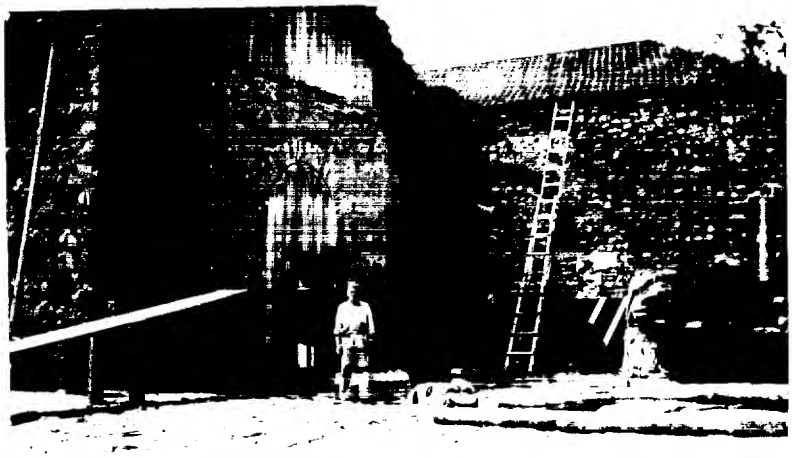
Mai- Ba mill. The concentrating tables are in the thatched building, and pumps and power equipment are in the building to the left. The mined sand stockpile is at the extreme upper right.

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Monazite mining controlled by FOMIL. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO MAI-BA 20 36 S 40 36 W
(WAC 1263) Monazite mining controlled by FOMIL. View of the mill from the beach. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A



AREA 233H BRAZIL ESPIRITO SANTO VITORIA 20 19 S 40 21 W
(WAC 1263) Monazite mining controlled by FOMIL. Rotary drier at the rear of Magnetic separator plant near Vitoria. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

AREA 233H BRAZIL ESPIRITO SANTO VITORIA 20 19 S 40 21 W
(WAC 1263) Magnetic separator plant near Vitoria. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

Magnetic separator plant, cross-belt magnetic separator, and rotary drier at the rear of the building.

AREA 233H BRAZIL ESPIRITO SANTO VITORIA 20 19 S 40 21 W (WAC 1263)
Monazite mining controlled by FOMIL. Cross-belt magnetic separator. 1948.
Restricted

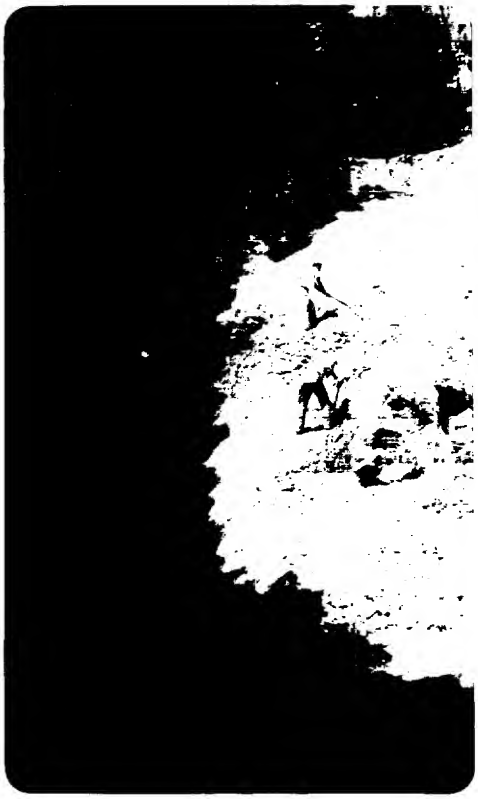
25X1A [redacted] [redacted] 25X1A

AREA 533H BRAZIL RIO DE JANEIRO SAPUCAIA 22 02 S 42 50 W
(Times Gazetteer) Beryl mine controlled by FOMIL. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A

AREA 533H BRAZIL RIO DE JANEIRO SAPUCAIA 22 02 S 42 50 W
(Times Gazetteer) Beryl mine controlled by FOMIL. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A



Sapacia beryl mine. The blasted pegmatite rock is hand picked for beryl as it is shoveled into a glory hole from which it is conveyed to the mine dump.

AREA 533H BRAZIL RIO DE JANEIRO SAPUCAIA 22 02 S 42 50 W
(Times Gazetteer) Beryl mine controlled by FOMIL. 1948.
Restricted

25X1A [redacted] [redacted] 25X1A